



SECTION 404

BITUMINOUS MIXING PLANTS

404.1 Description. This specification covers the requirements for mixing plants and equipment used in the production of bituminous mixtures.

404.2 Requirements for All Plants.

404.2.1 Aggregates. Sufficient storage space shall be provided for each size of aggregate. The different aggregate sizes shall be kept separated until they have been delivered to the combined cold feed belt. The storage yard shall be maintained neat and orderly and the separate stockpiles shall be readily accessible for sampling.

404.2.2 Asphalt Binder. An asphalt binder storage tank shall be provided at the proportioning and mixing plant. If more than one storage tank is used to deliver asphalt binder to the proportioning unit, piping and valve arrangements shall permit material to be used from any one of the tanks without using from another at the same time.

404.2.2.1 Each tank used for storage from which asphalt binder is delivered to the proportioning unit shall be equipped for heating the material under effective and positive control at all times to the temperature requirements set forth in [Sec 1015](#). Heating shall be by steam or oil coils, electricity, or other means such that no flame shall come in contact with the heating tank. The contractor shall furnish a tank capacity chart calculated in increments suitable for verifying quantities used during a normal production period.

404.2.2.2 A circulating system of adequate capacity shall provide proper and continuous circulation of the asphalt binder between storage tank and proportioning units during the entire operating period. The discharge end of the circulating pipe shall be maintained below the surface of the asphalt binder in the storage tank to prevent discharging into the open air. All pipe lines and fittings shall be steam or oil-jacketed or otherwise properly insulated to prevent heat loss.

404.2.2.3 The contractor shall provide in the asphalt binder feed lines connecting the plant storage tanks to the proportioning or injection system a sampling outlet consisting of a valve installed in such manner that samples may be withdrawn safely and slowly at any time during plant operation. The sampling outlet shall be installed between the pump and the return line discharge in such location that it is readily accessible. A drainage receptacle shall be provided for flushing the outlet prior to sampling.

404.2.3 Cold Aggregate Feeder. The plant shall be provided with an accurate mechanical means for uniformly feeding the aggregates into the drier to provide uniform production and temperature. A synchronized method of proportioning the aggregates at the cold feeder shall be provided. The gates of the fine aggregate cold feed bins shall be adjusted so that a steady, uniform stream of material is discharged.

404.2.3.1 For all plants producing bituminous mixtures composed of more than one fraction of aggregate, the aggregate cold feeds shall be calibrated as required by the engineer. The contractor shall provide a means to readily divert the flow of material into a container for

measurement. On the basis of the calibration, aggregate cold feeds shall be adjusted to ensure the proper percentage of the various aggregate fractions of the mix, as required by the job mix formula.

404.2.3.2 For plants producing SMA mixtures, each cold aggregate feeder shall be limited to a maximum of 30 percent of the total aggregate.

404.2.4 Drier. A drier of any satisfactory design for drying and heating the aggregate shall be provided. The drier shall be capable of drying and heating the aggregate to a temperature within the limits of the range specified in [Sec 1015](#) for the grade of asphalt binder used, without leaving any visible unburned oil or objectionable carbon residue on the aggregate. The mixture may be tested for contamination. Feeding and drying equipment shall be operated in such a manner that the temperature of the aggregates is maintained within 25 F (15 C) above or below that specified by the engineer. Absorbed moisture in the aggregate shall be reduced to such a quantity that there is no objectionable segregation of asphalt binder resulting from escaping water vapor in the prepared mixture. A maximum of 0.5 percent moisture based on weight (mass) of the mixture, will be allowed in the mixture when sampled and tested in accordance with MoDOT Test Method T53.

404.2.5 Dust Collector. An efficient dust collecting system shall be provided to prevent the loss of fine material into the surrounding environment. The material collected may be returned to the mixture at a uniform rate through an approved metering device, if approved by the engineer, or it may be wasted.

404.2.6 Screens. Continuous mix and batch-type plants used to produce mixtures in accordance with the requirements of [Sec 403](#) shall have screens with adequate capacity and size range to separate all of the aggregate into the specified sizes required for proportioning of the mixture being produced.

404.2.7 Bins. Continuous mix and batch-type plants shall have hot bin storage of sufficient capacity to ensure uniform and continuous operation. Bins shall be divided into compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate. Batch and continuous plants producing SMA mixture shall have a minimum of four separate hot bins. Each compartment shall be provided with an overflow pipe of such size and at such location as to prevent any backing up of material into other bins or into contact with the screen. The bins shall have a tailing pipe for rejections. The discharge points of overflow and tailing pipes shall be located so they will not create a hazard. Overflow pipes shall not return the material directly to the hot elevator.

404.2.7.1 If mineral filler or hydrated lime, or both, is required, adequate dry storage shall be provided, and provision shall be made for accurate proportioning.

404.2.7.2 Safe, adequate and convenient facilities shall be provided for obtaining representative aggregate samples from the full width and length of the discharge flow from each bin.

404.2.8 Asphalt Control Unit. Satisfactory means, either by weighing (by determining the mass) or metering, shall be provided to obtain the proper quantity of asphalt binder. Metering pumps for asphalt shall deliver accurately to within plus or minus 2.0 percent of the required quantity when tested for accuracy. Asphalt scales shall conform to the requirements of [Sec 404.3.5](#). If the quantity of asphalt binder is controlled by metering, provision shall be made whereby the delivery of the meter may be readily checked by actual weight (mass).

404.2.9 Thermometric Equipment. A thermometer of suitable range shall be fixed in the asphalt feed line at a suitable location near the discharge at the mixer unit. The thermometric

device included in the asphalt metering unit shall be displayed in a location readily accessible to the engineer.

404.2.9.1 In batch-type and continuous plants, an accurate registering pyrometer or other approved thermometric instrument shall be installed in the discharge chute of the drier in such manner that the temperature of the heated aggregate is automatically registered. Plants used to produce mixtures in accordance with the requirements of [Sec 403](#) shall be further equipped with approved recording thermometers, pyrometers or other recording thermometric instruments placed in two of the hot aggregate bins to register and record automatically the temperature of the heated aggregate. One terminal shall be placed in the hot bin containing the smallest aggregate used in the mix and the other terminal shall be placed in the bin containing the largest aggregate. The terminals shall be located where the hot material will flow around them during the proportioning operation and shall not be located near the corners of the bins or at points where the material will collect or pack around them. The charts shall continuously record both time and temperature. The smallest interval of time shown shall not be more than 15 minutes and the temperature graduations shall not be more than 10 F (5 C). The charts shall be furnished to the engineer at the end of each day's operation.

404.2.9.2 An approved recording thermometer, pyrometer or other recording thermometric instrument shall be installed in the discharge chute of drum mix plants in such manner that the temperature of the heated mixture is automatically registered and recorded. This instrument shall be located where it is in clear view of the plant operator and readily accessible to the engineer. The chart shall continuously record both time and temperature. The smallest interval of time shown shall be not more than 15 minutes and the temperature graduations shall be not more than 10 F (5 C). The chart shall be furnished to the engineer at the end of each day's operation. The terminal shall be maintained free of accumulated mixture to ensure accuracy.

404.2.10 Plant Calibration. Personnel, scales and equipment necessary for calibrating the plant and for verifying the accuracy of proportions shall be furnished by the contractor and shall be available at all times. If batch-type plants are used, the equipment shall include standard 50-pound (20 kg) test weights equal to 20 percent of the net load capacity of the scales, to the nearest 50-pound (20 kg) increment. However, not more than twenty 50-pound (20 kg) weights will be required. If batch-type plants are used, calibration of the batching scales by an approved commercial scale service shall be required at the beginning of each construction season or anytime the scales do not meet calibration tolerances. If less than 1000 tons (900 Mg) of mixture is required in a construction season for a project or combination of projects, no commercial scale service shall be required unless the scales do not meet calibration tolerances. If continuous mixing or drum plants are used, scales conforming to the requirements of [Sec 310.4.3](#), shall be provided. All equipment shall be calibrated in the presence of and subject to the approval of the engineer.

404.2.11 Safety Requirements. A conveniently located, easily opened gate or door shall be provided in the mixer cover for observation of pugmill mixing operations. Adequate and safe stairways to the pugmill mixer platform and sampling points shall be provided. Guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device to enable the engineer to obtain samples and mixture temperature data. All gears, pulleys, chains, sprockets and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed space shall be provided on the pugmill mixing platform. A clear and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free from drippings from the mixing platform.

404.2.12 Surge Bins. Approved surge bins may be used in the production of bituminous mixtures. They shall be equipped with batchers at the top of the surge bins, so located that the mixture is discharged vertically from the batcher into the center of the bin. Any mixture which the engineer determines visually to be segregated will be rejected.

404.2.12.1 Surge bins shall be covered and insulated. They shall be equipped with heating devices if necessary to maintain the temperature of the mixture in accordance with the requirements in [Sec 404.6.3](#).

404.2.12.2 Surge bins shall be equipped with automatic lights to indicate when the surface of the mixture has been drawn down to the top of the sloped portion of the bin. The bins shall also be equipped with an automatic locking device that prevents discharging mixture when the surface of the mixture has been drawn down to the top of the sloped portion of the bin. The automatic locking device may be unlocked by the engineer to terminate operations for the day or to dispose of the mixture off the highway right of way.

404.2.12.3 Mixture shall be transferred from the mixing plant to the surge bins by covered drag slat conveyors, skip hoists or other methods approved by the engineer. Mixture shall not be stored more than 8 hours.

404.2.12.4 Storage of SMA mixture shall be limited to the intermittent holding of the mix in the surge hopper while loading of trucks is performed, due to the tendency of the asphalt binder in SMA to drain from the mix.

404.2.13 Automatic Ticket Printer. For contracts having more than 10,000 tons (9000 Mg) of bituminous mixture, the asphalt plant shall be equipped with an automatic ticket printer connected to the weighing (mass determination) system in such manner that it automatically detects and prints the weight (mass) determined by the system. It shall store and recall the tare weight (mass) when the operator enters the vehicle identification. The weight (mass) shall be shown to at least the nearest 20 pounds (10 kg) or nearest one one-hundredth of a ton (megagram). The automatic printer shall be capable of keeping and printing cumulative totals for each project for each type of bituminous mixture. The automatic printer shall produce a ticket showing the weight (mass) for each load in triplicate that shows the following:

- (a) Gross, tare and net weights (masses).
- (b) Identification of the vehicle.
- (c) Current date and time.
- (d) MoDOT job mix number.
- (e) Job mix percent asphalt binder.
- (f) Unique ticket number (may be preprinted on the ticket).
- (g) Project number, job number, route, county.

The ticket shall accompany each load delivered to the project and shall be furnished to the engineer.

404.2.13.1 When the net weight (mass) of bituminous mixture is determined by batch weights (masses), the scales shall meet all requirements of [Sec 404.2.13](#) including automatic ticket printing, except the gross and tare weights (masses) will not be required.

404.2.13.2 When the net weight (mass) of bituminous mixture is determined from the gross weight (mass) of the loaded delivery vehicle, the net weight (mass) shall be determined from the gross weight (mass) of the loaded delivery vehicle less the empty delivery vehicle weight (mass). The empty delivery vehicle weight (mass) shall be determined daily or from time to time during the day as the engineer may direct.

404.2.13.3 At the end of each day's operation the contractor shall furnish to the engineer a total tonnage (quantity) of mixture produced by the asphalt plant in sufficient detail to determine the amount of asphalt binder used in that day's operation.

404.2.13.4 In the event of automatic ticket printer failure, the contractor may be allowed, with the engineer's approval, to furnish manually written tickets to complete that day's operation.

404.3 Requirements for Batch-Type Plants.

404.3.1 For all contracts having not more than 10,000 tons (9000 Mg) of bituminous mixture, standard manual batching methods, approved by the engineer, will be permitted. For contracts having more than 10,000 tons (9000 Mg) of bituminous mixture, required by [Sec 301, 401 or 403](#), batching plants shall be equipped to operate automatically to the extent that the only manual operation required for the proportioning of all ingredients for one batch shall be a single actuation of a switch or starter. The equipment shall include devices capable of automatically proportioning each ingredient of the mixture in the selected sequence and quantity. Interlocks shall be provided which will hold or delay the automatic batch cycling whenever the batched quantity of any ingredient is not within the specified tolerance. The weight (mass) setting and timing controls shall be suitably equipped so they may be locked when specified by the engineer. Manual operation will not be permitted beyond 24 hours after breakdown in the automatic equipment, except by written approval of the engineer.

404.3.2 Weigh Box or Hopper. The equipment shall include a means for accurately weighing (determining the mass of) aggregate from each bin into a weigh box or hopper, suspended on scales, and ample in size to hold a full batch without hand raking or running over. Weigh boxes shall be charged through only one gate opening for aggregate from each bin. The weigh box or hopper shall be supported on fulcrums and knife edges so constructed that they will not easily be thrown out of alignment or adjustment. Gates on the bins and the hopper shall be constructed to prevent leakage when they are closed.

404.3.3 Aggregate Scales. Scales for weighing (determining the mass of) aggregate and mineral filler or hydrated lime, or both, may be beam, springless dial or electronic digital weigh (mass determination) meter type, and shall be of standard make and design having tolerances on overregistration and underregistration not exceeding 0.4 percent of the indicated weight (mass) when tested for accuracy. Each aggregate fraction shall be measured within one percent of the total batch weight (mass) of the mixture. Mineral filler or hydrated lime, or both, shall be measured within 0.5 percent of the total batch weight (mass) of the mixture. The total weight (mass) of the batch shall be within 2.0 percent of the desired batch weight (mass). The change in load required to change the position of the rest of the indicating element or elements of a non-automatic indicating scale an observable amount shall not be greater than 0.1 percent of the nominal scale capacity. If manual batching methods are used, beam-type scales shall be equipped with a device to indicate to the operator that the required load is being approached. This device shall indicate at least the last 5 percent of the load weighed (determined) on any beam, except that this increment will not be required to be greater than 200 pounds (100 kg). Multiple beam-type scales shall be equipped with a tare beam and a separate beam for each size of aggregate. Dial scales shall be equipped with adjustable pointers for marking the weight (mass) of each material to be weighed (incorporated) into the batch. Graduation intervals for either beam or dial scales shall not be

greater than 0.1 percent of the nominal scale capacity. Quantity indicators necessary for batching shall be in full view of the operator.

404.3.3.1 Automatic volumetric batch proportioning approved by the engineer will be permitted and shall meet the tolerances specified in [Sec 404.3.3](#).

404.3.4 Asphalt Bucket. If a bucket is used for weighing (determining the mass of) the asphalt binder, it shall be of sufficient capacity to hold and weigh (determine the mass of) the quantity required for a batch in a single weighing (mass determination). The filling system and bucket shall be of such design, size and shape that asphalt will not overflow, splash or spill outside the confines of the bucket during filling and weighing (mass determination). The bucket shall be steam or oil-jacketed or equipped with properly insulated electric heating units.

404.3.5 Asphalt Scales. Scales for weighing (determining the mass of the) asphalt binder shall conform to the requirements for aggregate scales, as specified in [Sec 403.3.3](#), except a device to indicate at least the last 20 pounds (10 kg) of the approaching total load shall be provided. Asphalt binder shall be measured within 0.1 percent of the total batch weight (mass) of the mixture. Beam-type scales shall be equipped with a tare beam or adequate counter-balance for balancing the bucket and compensating periodically for the accumulation of asphalt on the bucket. Springless dial scales used for weighing (determining the mass of) asphalt binder shall have a tare beam, and a dial graduated in increments not to exceed 0.1 percent of the nominal scale capacity, and the maximum dial capacity shall not be more than 15 percent of the nominal capacity of the mixer.

404.3.6 Mixer Unit. The plant shall include an approved twin shaft pugmill mixer capable of producing a uniform mixture. The mixer shall be electrically heated or hot oil or steam jacketed and have a capacity of not less than 2000 pounds (900 kg) per batch. The mixer shall be constructed to prevent leakage of the contents, and the mixer box shall be equipped with a hood to prevent loss of dust.

404.3.6.1 The mixer shall be designed to provide means of adjusting the clearance between the mixer blades and liner plates to ensure proper and efficient mixing. Not more than one pair of paddle tips on each mixer shaft shall be reversed with respect to the other paddle tips on that shaft, except for mixers having forty paddles or more, then two pair may be reversed on each shaft. The reversed paddle tips shall be located in diagonally opposite corners of the pugmill. The clearance of blades from all fixed and moving parts shall not exceed 3/4 inch (19.0 mm).

404.3.6.2 The mixer shall have an accurate time lock to control the operation of a complete mixing cycle by locking the weigh box gate after the charging of the mixer until the closing of the mixer gates at the completion of the cycle. The time lock shall lock the asphalt bucket throughout the dry mixing period and shall lock the mixer gate throughout the dry and wet mixing periods.

404.3.6.3 A rating plate designating the manufacturer's rated capacity shall be attached to the mixer. The quantity of mixture produced per batch shall not exceed the manufacturer's rated capacity. The manufacturer's rated capacity will not be accepted unconditionally. If the mixer does not produce a satisfactory mixture or its production does not coordinate with other plant units, the right is reserved to reduce the size of the batch. The decision of the engineer as to the permissible capacity of the mixer shall be final.

404.4 Requirements for Continuous Mixing Plants.

404.4.1 Gradation Control Unit. The plant shall include a means of accurately checking the proportioning from each bin by weight (mass). Means shall be provided to establish the rate

of flow in pounds (kilograms) per revolution by scale weight (mass). On each of the storage bins for the heated aggregates, a device shall be installed to indicate when the level of the material in the bin is below the point where accurate proportioning through the feeder gates can be accomplished. These indicators shall be positive in action and shall actuate a clearly visible or audible signal to the plant operator or stop the flow of material to the mixer when the material in the bin is too low for accurate proportioning.

404.4.1.1 The gradation control unit shall include interlocked feeders mounted under the bin compartments. The interlocked feeders shall be equipped with a dustproof revolution counter registering to the nearest 0.01 revolution. The mix proportions shall be set up on the basis of pounds (kilograms) of aggregate from each bin per revolution. Each bin shall have an accurately controlled, individual gate to form an orifice to control the rate of flow of aggregate drawn from each respective bin compartment. The orifice shall be rectangular with one dimension adjustable by positive mechanical means. Locks shall be provided on each gate. Calibrated gauges with minimum graduations of not more than 0.1 inch (2 mm) shall be provided for each gate to establish gate openings. The rate of flow of the aggregate through the gate openings shall verify within 5 percent of the quantity as calibrated for that opening, or within 2 pounds (1 kg) per revolution of the aggregate feeder, whichever is the greater. The rate of flow shall also verify within a total variation of not more than 2 percent of the total quantity required of the combined bins, exclusive of mineral filler and hydrated lime, or one pound (0.5 kg) per revolution for each gate through which aggregate is being proportioned, whichever is the greater.

404.4.1.2 If mineral filler or hydrated lime, or both, is specified, a separate bin and feeder for each of these material shall be furnished with its drive interlocked with the aggregate feeders. Readily accessible ports or openings for observation of the flow of mineral filler or hydrated lime, or both, through the conveyor or delivery system shall be provided. The rate of flow of the mineral filler or hydrated lime feeder shall be accurate to within 0.5 percent of the rate of flow of the total mix, or to 1/2 pound (0.25 kg) per revolution of the aggregate feeder, whichever is the greater.

404.4.2 If a continuous mixing plant is used, a continuously registering measurement meter and a pressure gauge shall be installed in the asphalt line at locations meeting the approval of the engineer. The meter shall be cumulative with a nonsetback register, and have an accuracy within 2 percent by weight (mass) of the material actually being measured in any given period of time. The meter register shall indicate the quantity measured to the nearest 0.25 gallon (one liter) or less. The pressure gauge shall have a range capable of registering all spraying pressures during plant operation and the dial shall have increments of not more than one pound per square inch (10 kPa). The meter and the pressure gauge shall be so located in the asphalt line that the meter will continuously register the asphalt discharge and the gauge will continuously register the discharge or spraying pressure, and also so that the discharge through both the meter and the gauge can be readily diverted to a container for measurement. During calibration and verification of the asphalt metering pump and the measurement meter, the discharge pressure shall be controlled by a valve or reduction unit to duplicate the plant's spraying pressure. The accuracy of the measurement meter shall be verified at periodic intervals as specified by the engineer. In case of meter malfunction, plant operation will not be permitted beyond 24 hours after detection except by written approval of the engineer.

404.4.3 Weight (Mass) Calibration of Asphalt and Aggregate Feed. The plant shall include a means of calibrating gate openings and asphalt flow by means of weighed (mass determination of) test samples in pounds (kilograms) per revolution. The aggregate fed out of the bins through individual orifices shall be bypassed into suitable test boxes and each compartment material shall be confined in individual test receptacles or compartments. Accessories shall be supplied so that the aggregate weight (mass) in each compartment may be determined separately. Test containers shall be of a size to obtain a minimum weight of 200

pounds (minimum mass of 90 kg), or the quantity from not less than five complete revolutions, whichever is the smaller, for each test-run made from each bin. In any case, the quantity from not less than one complete revolution will be required.

404.4.4 Synchronization of Aggregate and Asphalt Feed. Satisfactory means shall be provided to afford positive interlocking between the flow of aggregate through the gates, the flow of mineral filler or hydrated lime through each feeder, and the flow of asphalt binder through the meter or other proportioning source. Means shall be provided to check the rate of flow of the asphalt binder by scale weight (mass) per revolution. The pump shall deliver the asphalt to the pugmill at a uniform rate which shall not vary more than 2.0 percent by weight (mass) from the required quantity.

404.4.5 Mixer Unit. The plant shall be equipped with a twinshaft, electrically heated or hot oil or steam jacketed pugmill, capable of producing a uniform mixture within the permissible job-mix tolerances. It shall have a capacity of not less than 40 tons (35 Mg) per hour. The paddles shall be of a type adjustable for angular position on the shafts and reversible to retard the flow of the mix. The clearance of blades from all fixed and moving parts shall not exceed 3/4 inch (19.0 mm). Mixers shall be equipped with discharge hoppers or other facilities to prevent segregation during discharge.

404.4.5.1 The mixer shall carry a manufacturer's plate giving the net volumetric content of the mixer at the several heights inscribed on a permanent gauge. The manufacturer's rating of the mixing unit will not be accepted unconditionally. The right is reserved to reduce the rate of feed of aggregate at plant-operating speed to produce a satisfactory mixture. The decision of the engineer as to the permissible capacity of the mixing unit shall be final.

404.4.5.2 The mixing time shall be determined as follows:

$$\begin{array}{lcl} \text{Mixing time} & = & \frac{\text{Pugmill dead capacity in pounds (kilograms)}}{\text{Pugmill output in pounds (kilograms) per second}} \\ \text{in seconds} & & \end{array}$$

404.5 Requirements for Drum Mix Plants.

404.5.1 The plant shall be specifically designed for drum mixing and be capable of satisfactorily heating, drying and mixing the bituminous mixtures. The system shall be equipped with automatic burner controls, and heating shall be controlled to prevent damage to the aggregate or the asphalt binder. The temperature of the mixture when discharged from the mixer shall be within the range specified in [Sec 1015](#) for the grade of asphalt binder being used. The rate of flow through the drum shall be controlled in order that the bituminous material and aggregate shall be mixed until a homogeneous mixture with all particles uniformly coated is obtained and in no case shall the quantity of mixture produced exceed the manufacturer's rated capacity.

404.5.2 Each feeding orifice shall have an adjustable gate with an indicator provided to reference the opening setting. On each of the aggregate feeders, a device shall be installed to indicate when the flow of material from the bin is below the point where accurate proportioning through the feeder gates can be accomplished. These indicators shall be positive in action and shall actuate a clearly visible or audible signal to the plant operator or stop the flow of material to the drum when the level of material in the bin is too low for accurate proportioning. In addition, for those particular cold bins whose aggregate material tends to either bridge or lump together causing temporary interruptions in feeds, a vibrator or other suitable means shall be provided to ensure uniform flow. The order of aggregate feed onto the composite cold feed belt shall be from coarse to fine. When only one aggregate is furnished, two cold bins shall be used. A scalping screen mounted independent of other

proportioning or weighing (mass determination) equipment shall be required if directed by the engineer.

404.5.3 Asphalt binder shall be introduced through a continuously registering cumulative indicating meter by a pump specifically designed for drum mix plants. The meter shall be located in the asphalt line so that it will continuously register the asphalt discharge to the mixer and so that the discharge through the meter can be readily diverted into a container for measurement. The meter shall be equipped with a nonsetback register and shall have an accuracy within 2 percent by weight (mass) of the material actually being measured in any given period of time. The nonsetback register shall register only the asphalt discharged to the mixer and shall not record asphalt circulated back to the storage tank. A device shall be provided in the asphalt storage tank to indicate when the supply of asphalt to the pump and metering device is such that accurate proportioning is not accomplished. The accuracy of the pump and meter shall be verified at periodic intervals as designated by the engineer.

404.5.4 If mineral filler or hydrated lime, or both, is specified, a separate bin and feeder for each material shall be furnished and each material shall be dispensed by weight (mass) by continuous batching device. The batching device shall have a continuous weight (mass) display in clear view of the plant operator. The delivery system shall be variable speed and interlocked with the aggregate weigh belt so the total dry aggregate weight (mass), including mineral filler or hydrated lime, or both, is indicated to the asphalt proportioning system. A continuously registering, cumulative, nonsetback register shall record the quantity of mineral filler or hydrated lime, or both, discharged into the mixer. Mineral filler and hydrated lime shall be introduced and uniformly dispersed into the drum mixer at the point of introduction of the asphalt binder without loss to the dust collection system. The mineral filler and hydrated lime proportioning and delivery system shall have an accuracy of 10 percent by weight (mass) of the material actually being measured in any given period of time.

404.5.5 Positive weight (mass) measurement of the combined cold feed aggregates shall be by use of belt scales. The combined cold aggregate feed shall be continuously recorded on a nonsetback register. The belt scale shall have an accuracy within 2 percent by weight (mass) of the material actually being measured in any given period of time. The accuracy of the belt scales shall be verified at periodic intervals as directed by the engineer. Means shall be provided to readily divert the flow of cold feed aggregates into a container for measurement. The scale and the conveyor at the scale shall be protected from wind and weather effects. The plant shall be equipped so that the proportion of each aggregate can be individually varied. The plant shall also be equipped so that the total aggregate rate can be varied without affecting the proportions of each individual aggregate.

404.5.6 Positive weight (mass) measurement of reclaimed asphaltic pavement shall be by use of belt scales complying with the requirements of [Sec 404.5.5](#).

404.5.7 The aggregate feed system, reclaimed asphaltic pavement feed system if recycling is permitted, mineral filler or hydrated lime, or both if specified, and the asphalt flow shall be interlocked by a blending system which will automatically regulate the asphalt binder, mineral filler, hydrated lime and reclaimed asphaltic pavement flow and cause synchronized corrections for variations in aggregate flow. The blending system shall include a moisture compensating device to correct for the moisture in the aggregates passing over the belt scales. Moisture determinations will be made periodically during each day's operation. The blending system shall also include a device to correct for changes in the specific gravity of the asphalt binder.

404.5.8 Safe, adequate and convenient facilities shall be provided for obtaining representative samples of asphalt binder, cold aggregate and bituminous mixture. The plant shall be equipped with sampling devices capable of providing a sample of sufficient size from the full

width of the combined aggregate flow and from the full width of the mixer discharge flow. Sampling devices shall be designed so that samples may be taken while the plant is operating at normal production rates.

404.5.9 Safe, adequate and convenient facilities shall be provided for calibrating or verifying the asphalt binder, mineral filler, hydrated lime, reclaimed asphaltic pavement and the aggregate nonsetback registers. The manufacturer's recommendations shall be followed for calibration when not in conflict with these specifications. To calibrate or verify the aggregate, mineral filler, hydrated lime or reclaimed asphaltic pavement nonsetback register, means shall be provided to permit a positive and uniform diversion of the material in sufficient quantity for accurate weight (mass) checks. To calibrate or verify the asphalt nonsetback register, an asphalt distributor or other equipment approved by the engineer shall be made available so that an accurate tare, gross and net weight (mass) may be obtained of the diverted asphalt discharge. If necessary, manual overrides of the equipment shall be provided for calibration or verification purposes. The quantities of aggregate and asphalt binder measured in any given period of time shall not vary by more than 2.0 percent by weight (mass) from the required quantity of each.

404.5.10 A surge bin in accordance with [Sec 404.2.12](#) will be required unless otherwise authorized by the engineer.

404.6 Preparation of Asphalt Binder, Aggregates and Mixtures.

404.6.1 Drum Mix Plants. Preparation of asphalt binder, aggregates and mixtures shall be in accordance with the applicable requirements of [Sec 404.5](#).

404.6.2 Batch-Type and Continuous Mixing Plants.

404.6.2.1 Preparation of Asphalt Binder. Asphalt binder shall be heated in either steam, electric or oil heated tanks or kettles and shall be maintained during the period that mixture is manufactured, at a temperature within the limits of the range specified in [Sec 1015](#). If asphalt binder is measured by volume, the temperature of the asphalt binder at the time of measuring shall not vary more than 15 F (8 C) from that specified by the engineer when the metering device was calibrated. The equipment for handling the asphalt, including pumps, pipe lines and storage tanks, shall be entirely separate and have no connections to the system used for handling fuel oil or other material on the project.

404.6.2.2 Preparation of Aggregate. The mineral aggregate shall be fed into the drier through approved aggregate feeders which will accurately control the total and proportional feed. Each fraction shall be proportioned through a separate mechanical feeder. If the aggregate is furnished in one fraction, a minimum of two cold aggregate feeders will be required. The temperature of the aggregate, when delivered to the mixer, shall be within the range specified in [Sec 1015](#), for the grade of asphalt binder being used.

404.6.2.3 Preparation of Mixture.

404.6.2.3.1 Aggregate from each hot bin, mineral filler or hydrated lime, if specified, and asphalt binder shall be accurately proportioned in the quantities required by the job-mix formula.

404.6.2.3.2 Batch-Type Plants. Aggregate shall be charged into the weigh hopper in a sequence that will avoid segregation. The mineral aggregate for mixtures specified in [Sec 301](#), [401](#), and [402](#) shall be mixed dry for not less than 10 seconds, and for mixtures specified in [Sec 403](#) shall be mixed dry for not less than 15 seconds. The dry mixing period for Type I-B mixtures may be decreased to not less than 10 seconds, provided there is no segregation of

the aggregates. The dry mixing period shall start when all of the mineral aggregates have been charged into the mixer and end when the introduction of the asphalt binder begins. After dry mixing, the asphalt binder shall be charged into the mixer in a manner that will uniformly distribute the asphalt over at least 3/4 of the full length of the mixer. The time required to add the asphalt binder shall not exceed 15 seconds. Wet mixing shall begin at the introduction of the asphalt binder and continue for at least 30 seconds, or longer if necessary to produce a complete and uniform coating of the particles and a thorough distribution of the asphalt binder throughout the aggregate. The wet mixing period shall end when the discharge gate is opened. The dry and wet mixing times shall be as specified by the engineer.

404.6.2.3.3 Continuous Mixing Plants. The mixing period shall be determined in accordance with [Sec 404.4.5.2](#) and shall be not less than 35 seconds. The mixing time shall be as specified by the engineer, and may be increased above the minimum specified if necessary to produce a complete and uniform coating of the particles and a thorough distribution of the asphalt binder throughout the aggregate.

404.6.3 Final Mixture. The final mixture, when discharged from the pugmill or drum, shall not vary more than 25 F (15 C) from 300 F (150 C) unless otherwise specified by the engineer, and in all cases shall be within the same range as that specified in [Sec 1015](#) for the grade of asphalt binder being used.

404.6.4 SMA Mixtures. A homogeneous mixture shall be produced.

404.6.4.1 For batch plants, fibers shall be added to the mineral aggregates either in the weigh hopper or in the pugmill. The fibers shall be accurately added by weight (mass), either manually by bag or other measure, or by an approved weight (mass) metering device. If fibers are added in the weigh hopper, no fibers shall be added until mineral aggregate from at least one hot bin has been placed in the weigh hopper. If fibers are added in the pugmill, the fibers shall be added immediately after the mineral aggregates and before the asphalt binder is added.

404.6.4.1.1 The mineral aggregates and the fibers shall be dry mixed for at least 20 seconds and a maximum of 35 seconds.

404.6.4.1.2 The wet mixing time shall not be less than 35 seconds to allow the cellulose fibers to expand and ensure adequate distribution of the fibers and asphalt binder.

404.6.4.1.3 Dry and wet mixing times and batch mixing temperatures may be otherwise adjusted as necessary by the engineer.

404.6.4.2 For drum and continuous mix plants, fibers shall be introduced into the plant in either loose or pelletized form.

404.6.4.2.1 Metering fibers into the plant requires specialized equipment to ensure a consistent, uniform blending of the fibers into the mixture and shall be accomplished as specified by the manufacturer of the equipment to the satisfaction of the engineer. The metering system shall be variable speed and shall proportion the fibers by weight (mass).

404.6.4.2.2 If used in a drum mix plant, pelletized fiber shall be added directly into the drum mixer through the recycle asphalt inlet.

404.7 Hauling Equipment. Trucks used for hauling bituminous mixtures shall have tight, clean, smooth, metal beds which have been thinly coated with a minimum quantity of lime solution or an approved bituminous mixture release agent meeting the requirements of [Sec 1071](#) to prevent the mixture from adhering to the beds. Use of diesel fuel, fuel oil or other

detrimental products as a bed coating will not be allowed. The release agent shall not be diluted less than the minimum rate specified by the manufacturer and shall be applied with equipment as recommended by the manufacturer. Dilution shall not be by diesel fuel or other petroleum products.

404.7.1 Each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture from the weather. The cover shall be securely fastened over all sides of the truck bed. When necessary, so that the mixture will be delivered on the road at the specified temperature, truck beds shall be insulated. No loads shall be sent out so late in the day that spreading and compacting of the mixture cannot be completed during daylight, unless there is adequate lighting in the area of work.